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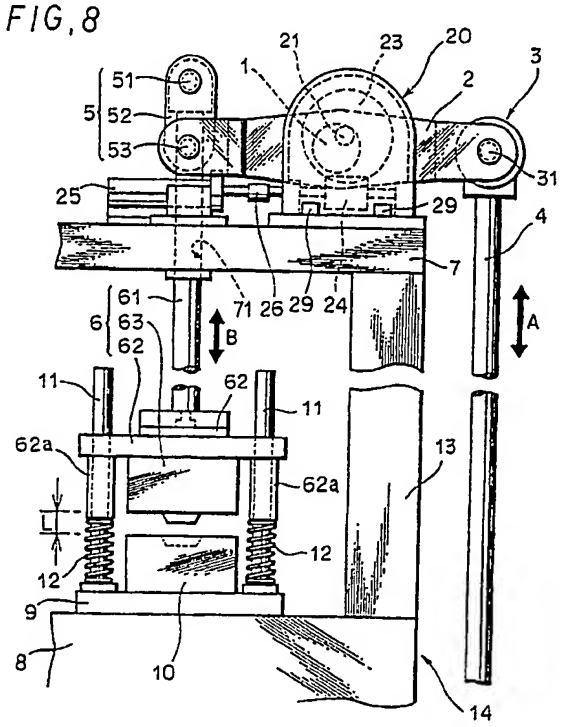
(54) **Adjusting the position of a reciprocating member of a press**

(57) A method of automatically adjusting the position of a reciprocating member 6 comprises detecting pressurising force applied by the member 6 at its bottom of dead centre and adjusting the position of the bottom dead centre of the member 6 by elevating the member by a prescribed amount based on the measured value of the pressurising force, when the measured value of the pressurising force is outside upper and lower limits of the tolerance range of the pressurising force. The member 6 is elevated using eccentric 23 engaged by a worm gear 24 which is turned by a servo motor 25 in dependance on signals from strain gauge 29.

FIG,8



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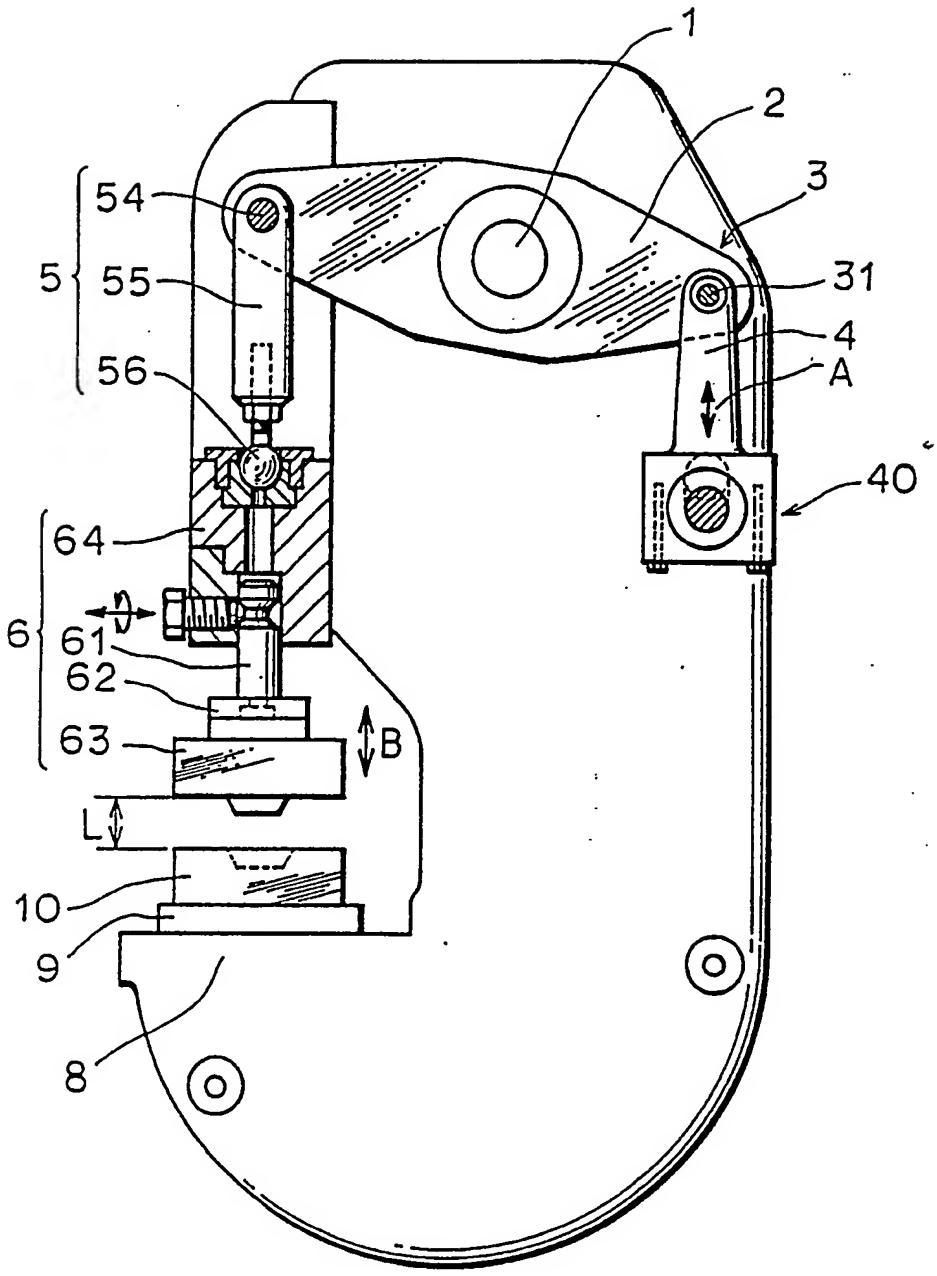
FIG, 1



FIG, 2

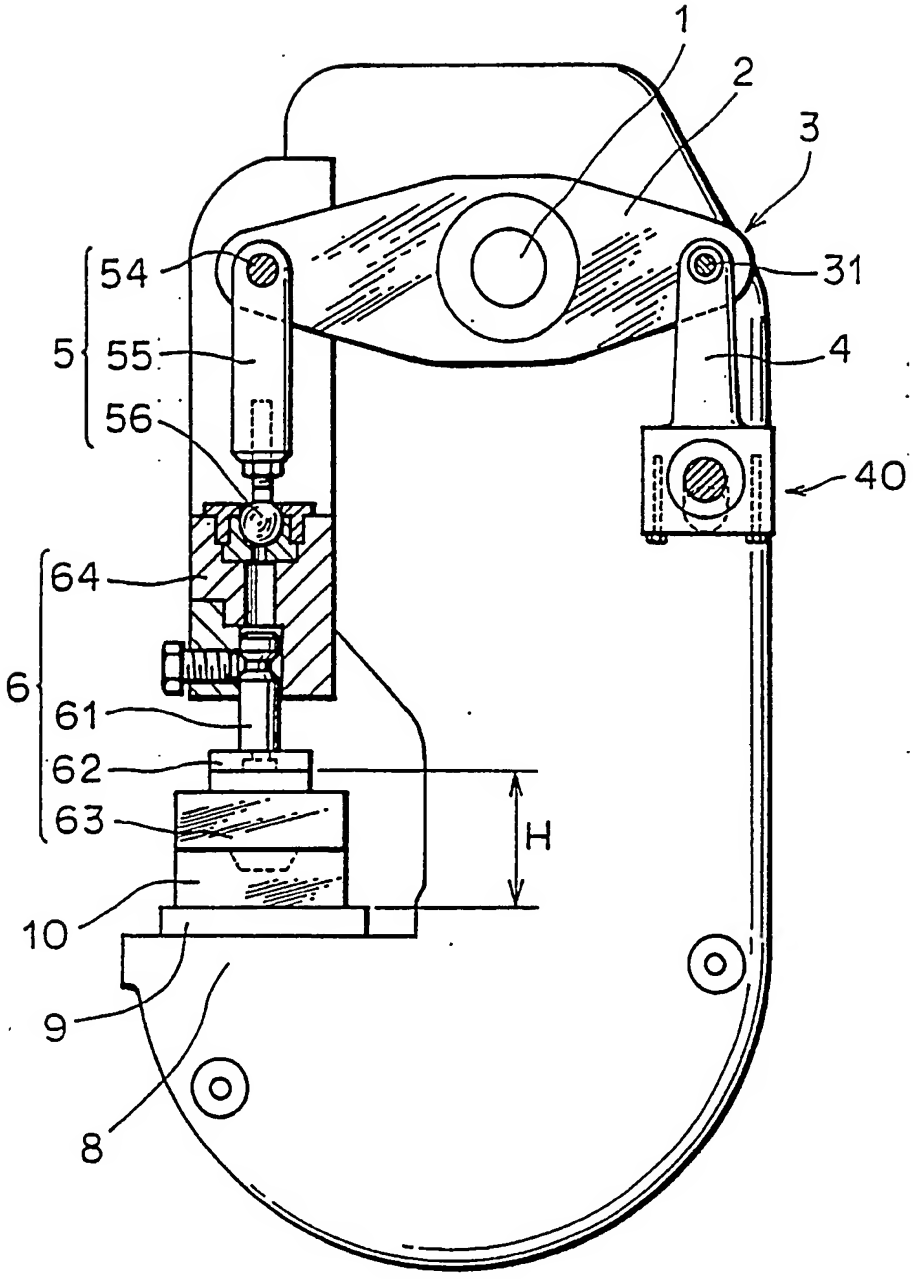


FIG. 3

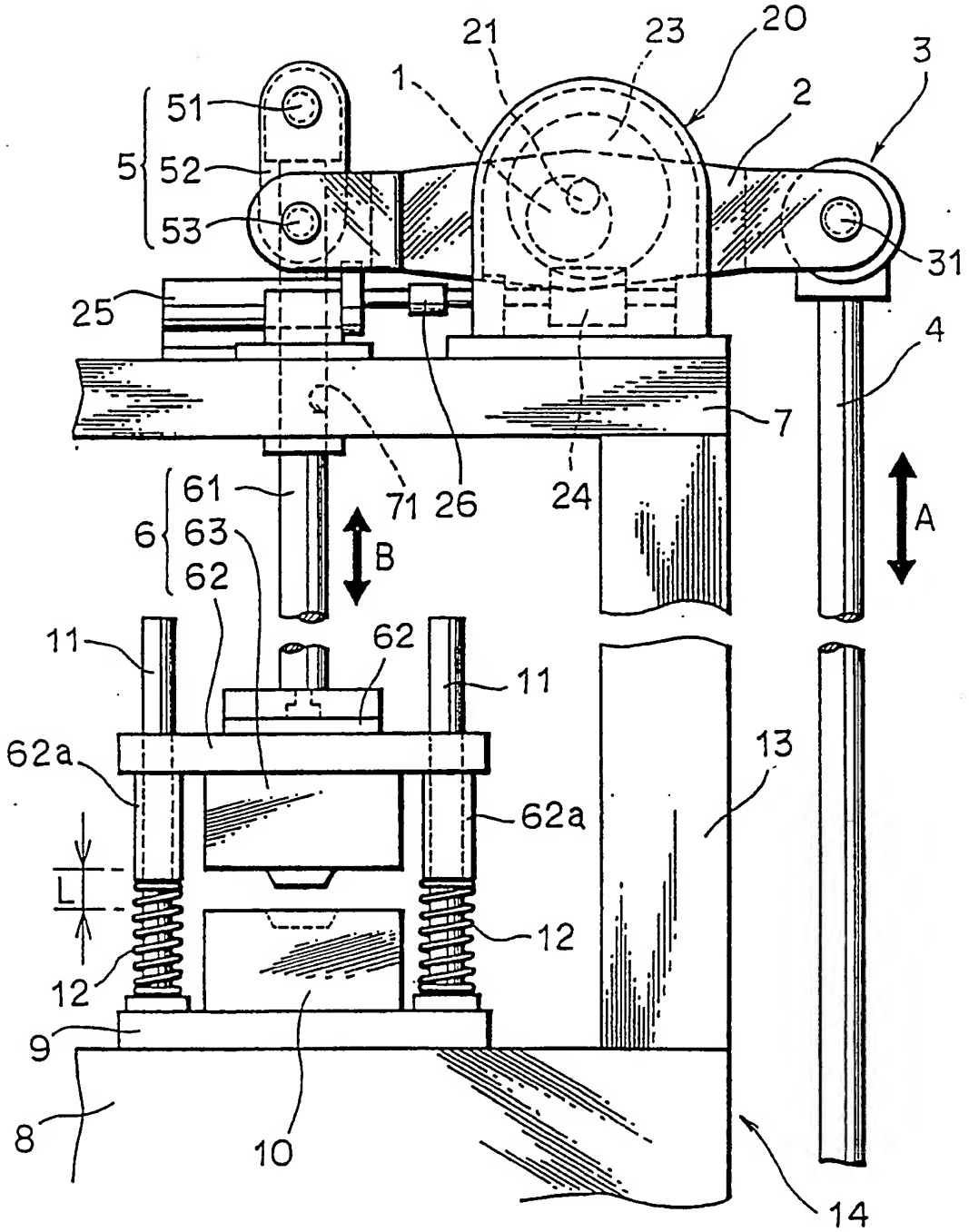

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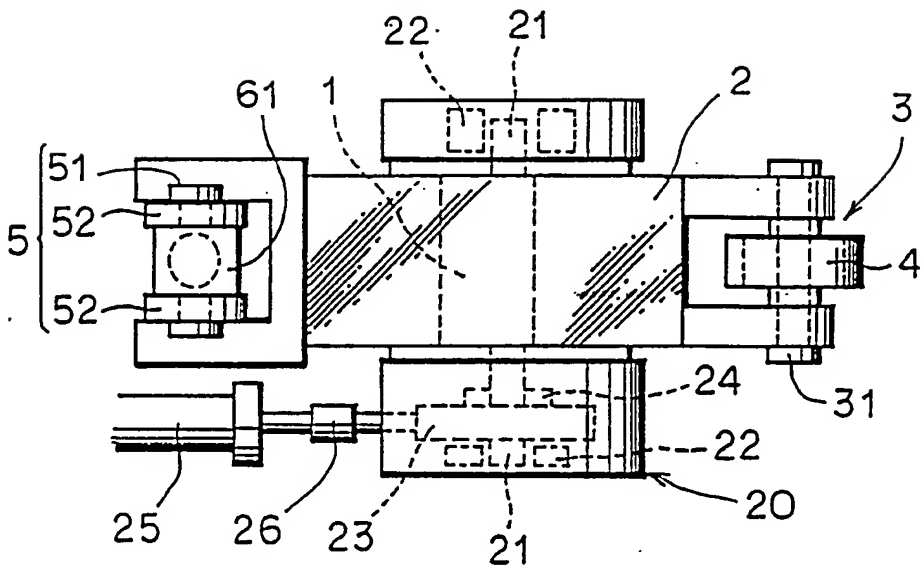
FIG. 4



FIG,5

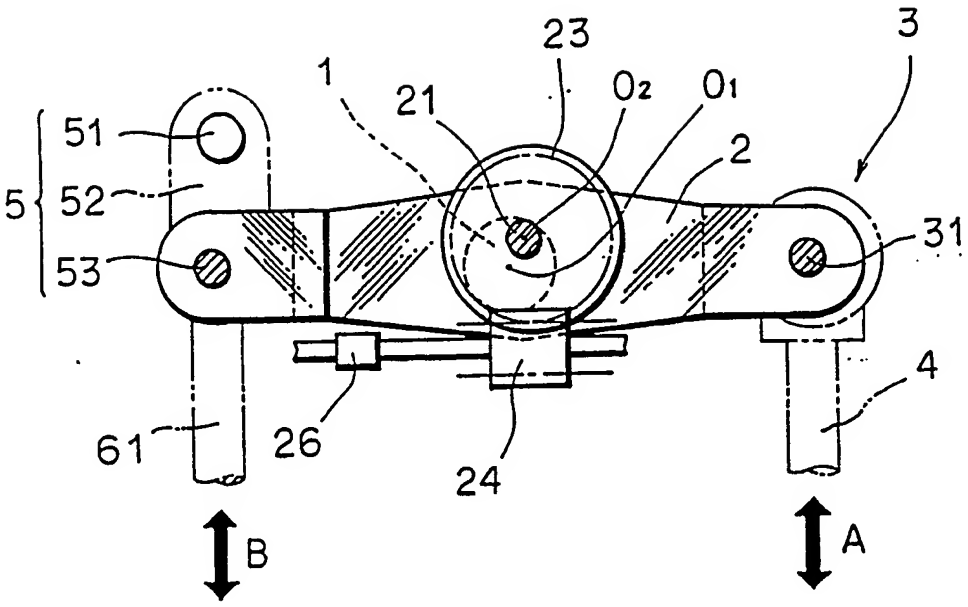


FIG. 6

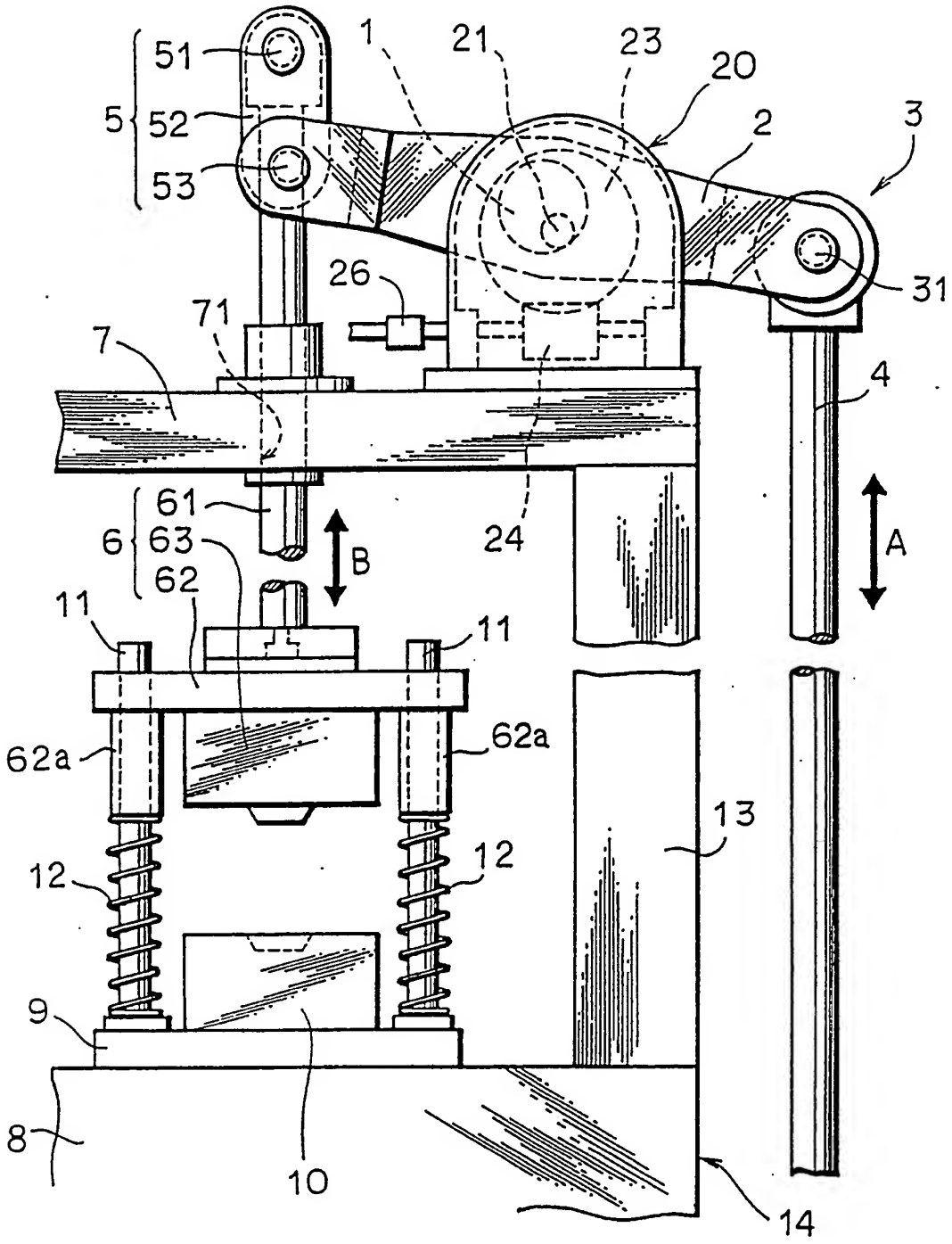

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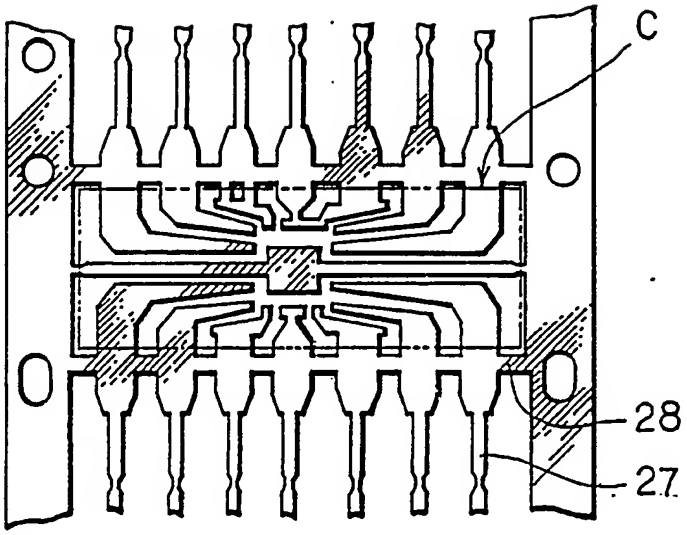
FIG. 7



FIG, 8

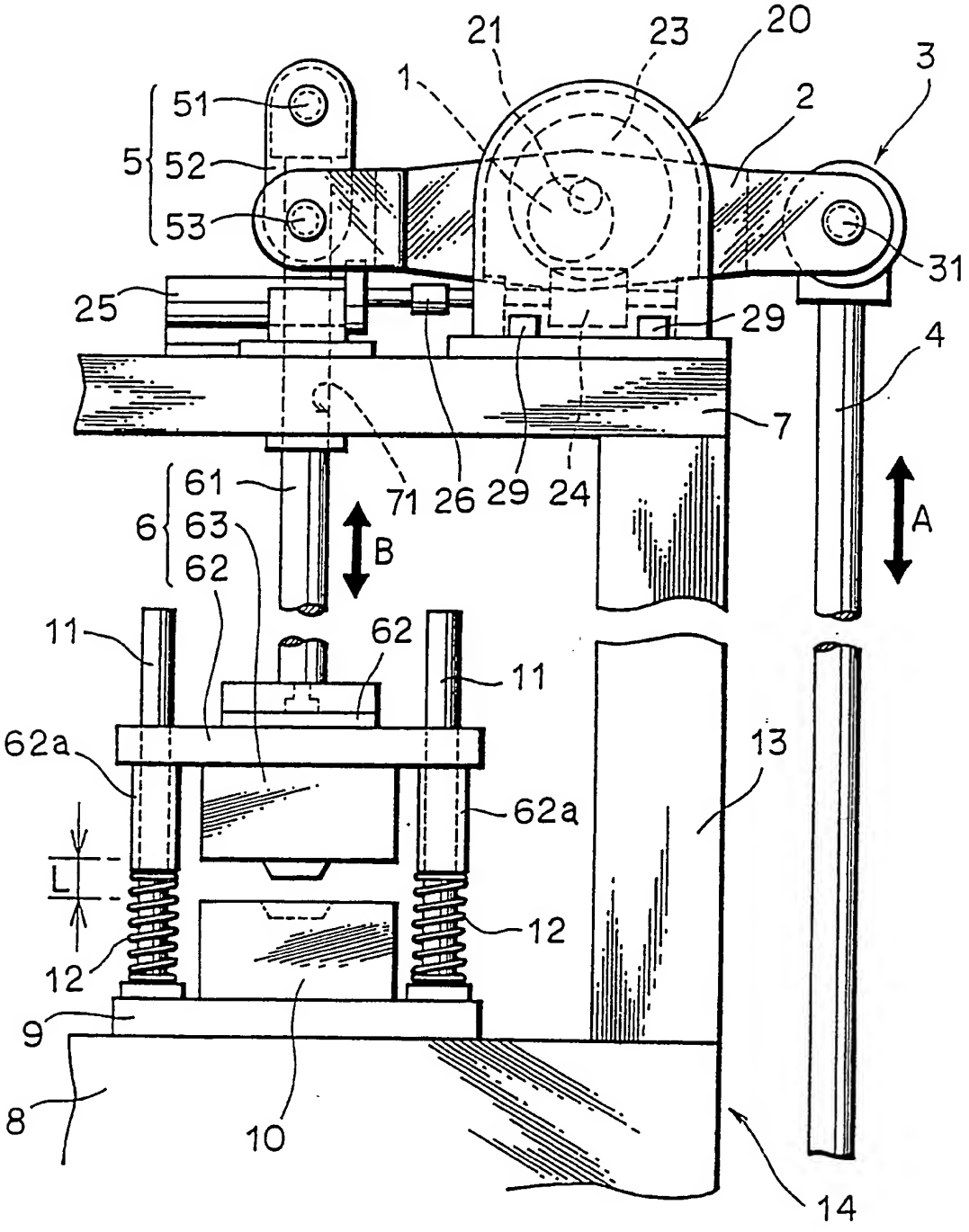

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FIG. 9

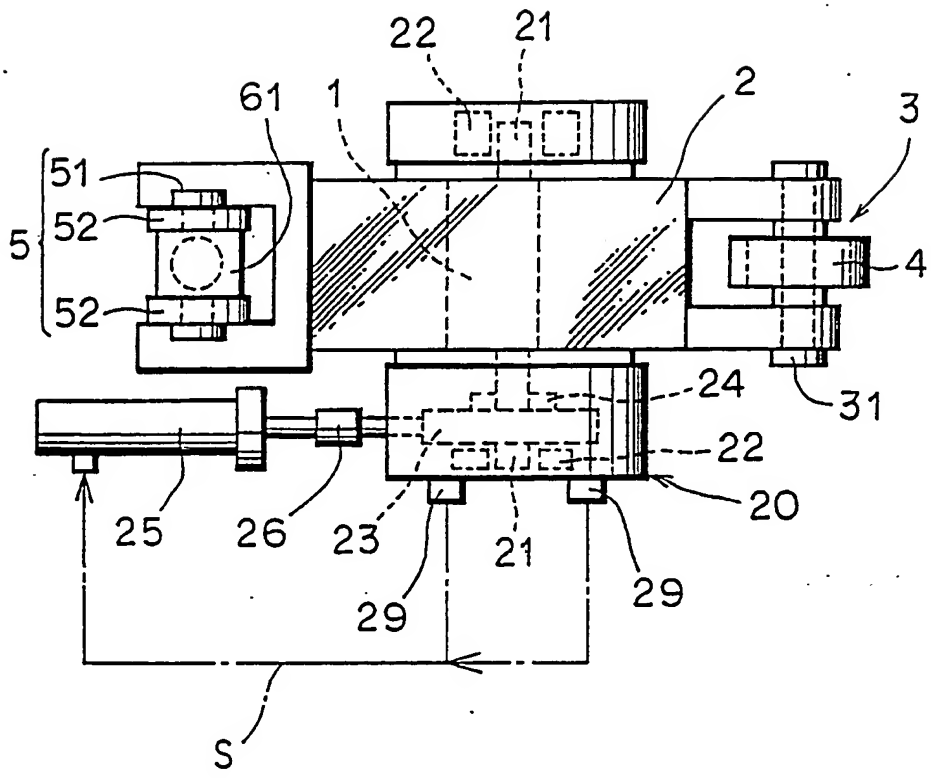
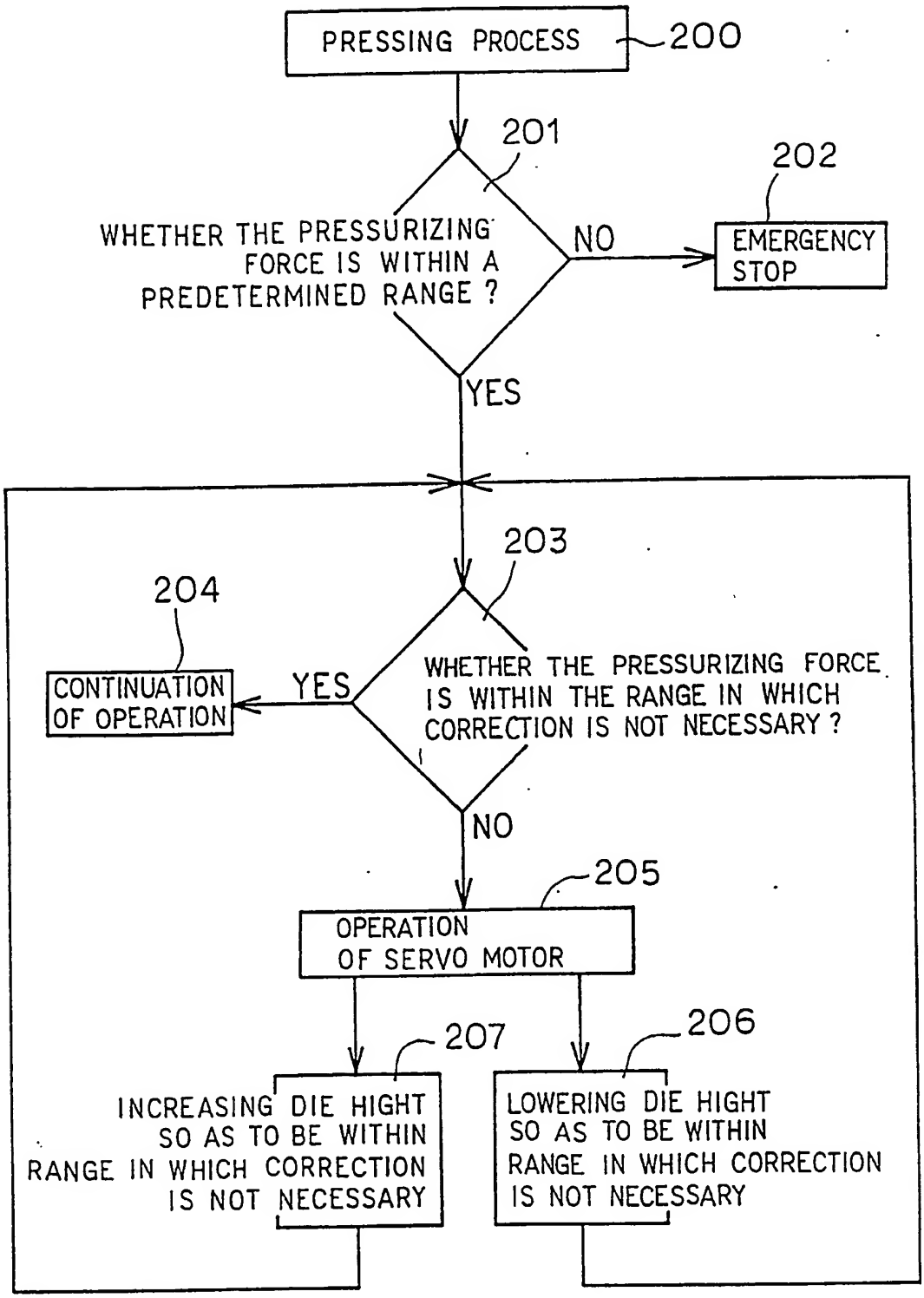


FIG. 10


PRESSING PROCESS
200
201
WHETHER THE PRESSURIZING FORCE IS WITHIN A PREDETERMINED RANGE ?
NO
202
EMERGENCY STOP
YES
203
204
CONTINUATION OF OPERATION
YES
WHETHER THE PRESSURIZING FORCE IS WITHIN THE RANGE IN WHICH CORRECTION IS NOT NECESSARY ?
NO
205
OPERATION OF SERVO MOTOR
207
206
INCREASING DIE HIGHT SO AS TO BE WITHIN RANGE IN WHICH CORRECTION IS NOT NECESSARY
LOWERING DIE HIGHT SO AS TO BE WITHIN RANGE IN WHICH CORRECTION IS NOT NECESSARY

TITLE OF THE INVENTION

Method of Adjusting Setting Position of Reciprocating Sliding Member and Press Using Such Apparatus

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a method of automatically adjusting the pressurizing force of a press by automatically adjusting the setting position of a reciprocating sliding member, and a press to which the method is applied.

Description of the Related Art

In recent years, a medium sized or a small sized press having a relatively short stroke length is often used in the formation of the parts of precision machinery, or in the cutting or bending process of the lead frames of electronic parts such as ICs (Integrated Circuits). A

crank press which moves its main slide by its crank mechanism is generally known as such a conventional medium or small sized press.

A conventional rocker arm type power press shown in "Puresu Benran (Handbook of Press) published by Maruzen, p247" for example will be described as an example of a conventional crank press in conjunction with Figs. 1 and 2.

The rocker arm type power press shown in Figs. 1 and 2 includes a rocker arm 2 disposed pivotably about an axis 1 fixed to its main body, a connecting rod 4 coupled pivotably to one end of the rocker arm 2 at a connecting part 3, and a sliding member 6 coupled pivotably to the other end of rocker arm 2 at a connecting part 5 by shafts 54, a link 55 and a universal joint 56. Sliding member 6 includes a slide 64 directly connected to the universal joint 56, a shank 61 fixed to the slide 64, and an movable upper die 63 having a setting member 62 at the tip end of the shank. A lower die 10 is fixed to the top of a bolster plate 9 fixed to the top of a base 8.

Having a structure as described above, the conventional rocker arm type power press shown in Fig. 1 operates as follows.

Up and down reciprocating driving force (indicated by arrow A in Fig. 1) from a crank 40 acts upon connecting

rod 4. The reciprocating driving force is transmitted to rocker arm 2 through connecting part 3, and rocker arm 2 swings about axis 1 as a result. The pivotal movement of connecting part 5 caused by the swinging of rocker arm 2 is transformed into the up and down reciprocating movement (indicated by arrow B in Fig. 1) of shank 61, causing the up and down reciprocating movement of upper die 63.

When pressing work is conducted by such a conventional power press, a work piece (not shown) is inserted between upper die 63 and lower die 10 in the state as shown in Fig. 1 in which upper die 63 is at the upper end of its stroke, in other words the position of its top dead center. Then, as connecting rod 4 rises operated by crank 40, upper die 63 descends, reaching to the position at which the work piece is pressed between movable upper die 63 and fixed die 10, in other words the position of its bottom center (the state shown in Fig. 2).

A size L shown in Fig. 1 represents the stroke length of upper die 63 or sliding member 6, and a dimension H shown in Fig. 2 represents a so-called die height. A die height is generally defined at the distance between the bottom surface of the ram of a press and the top of a bolster plate when an upper die is at the position of its bottom dead center, however, above mentioned dimension H indicates the distance between the bottom surface of shank

61 fixed to slide (ram) 64 and the upper surface of bolster plate 9, corresponding to the structure of an embodiment of the present invention (see to Fig. 3).

The stroke length L of sliding member 6 in, for example, a medium sized/small sized press represented by the above-described arm type power press is often in the range of 30mm to 50mm, because a work piece processed by the press is relatively small. When abnormal situations take place in the dies (upper die 63 and lower die 10 in the case of the above-described conventional example) of a small press having such a short stroke length L, cumbersome operations are necessary, such as taking the work piece out of the dies, re-adjusting the dies, or other associated maintenance and inspection operations.

More specifically, in the case of the above-stated conventional press, in the process of taking out the work piece or overhauling the dies at the time of abnormality, the dies must be taken out of the machine to undergo necessary operations, and thereafter be reset to the machine. Not only the troublesome operations of taking out and resetting the dies, but also a huge amount of labor is required for the delicate adjustment of stroke length or die height at the time of resetting, resulting in degradation in productivity as a whole.

Also, not only in a medium/small sized press having a

relatively small stroke length but also in a large sized press, the adjustment of its die height H is conducted by the following process.

Firstly, a reciprocating sliding member such as a ram (shank 61 in the above-described conventional example) is set at a position of a suitable height, a work piece is pressed, and the correction of the die height H is made after the inspection of the state of the pressed product. In order to determine an appropriate die height, the adjusting operation including pressing, inspection, and correction as described above must be carried out a number of times, and the troublesome operation requires skilled labour, degrading resultant productivity.

A conventional press is known, which is provided with an overload safety mechanism in which a load gauge electrically disconnects a clutch upon detection of an emergency state when the press is overloaded, in other words the pressure imposed upon is beyond a predetermined pressuring force, to stop the operation of the machine. Stopping the operation of the machine for every occurrence of such an overload as a state of emergency requires labour for resetting the machine for every occasion, also resulting in poor productivity.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method of appropriately and automatically adjusting pressurising force by automatically adjusting the position of a member sliding reciprocally for pressurising a work piece at its bottom dead centre, and a press to which the method is applied.

According to one aspect of the invention there is provided a method of adjusting automatically the position of setting a reciprocating sliding member, comprising the steps of:

detecting pressurising force applied by a sliding member at the bottom dead centre of said sliding member; and

adjusting the position of the bottom dead centre of said sliding member by elevating said sliding member by a prescribed amount based on the measured value of the pressurising force, when the measured value of the pressurising force detected in the step of detecting pressurising force is out of the upper limit and lower limit of the tolerance range of the pressurising force.

In accordance with this method, pressurising force at the bottom dead centre of the sliding member is automatically detected, the position of the sliding member is automatically adjusted when the detected pressurising force is out of the tolerance range, thereby adjusting automatically the pressurising force to be in the range of tolerance. The pressurising force at the bottom dead centre of the slid member is thus always appropriately and automatically adjusted.

According to another aspect of the invention there is provided a press, comprising:

a sliding member capable of reciprocating, for pressurising a work piece at its bottom dead centre;

a reciprocating driving mechanism for driving said sliding member to reciprocate,

pressurising force automatic detecting portion for automatically detecting pressurising force at the bottom dead centre of said sliding member; and

an automatic elevating mechanism for automaticaly elevating/lowering the position of said sliding member at its bottom dead centre, based on a pressurising force detecting signal obtained from said pressurising force automatic detecting portion.

Having a structure as described above, a press capable of automatically correcting force of pressurising a work piece can be implemented.

In a preferred embodiment of the press, its reciprocating driving mechanism includes an arm swinging about an axis, and a member coupled pivotably to one end of the arm for transmitting driving force. A sliding member for pressurising a work piece is at least pivotably coupled to the other end of the arm, and the sliding member is caused to reciprocate by the swinging of the arm.

In another preferred embodiment of the press, an automatic elevating mechanism secures the rotating axis of a worm wheel to an axis to be the centre of the swinging of the arm, rendering the centre of the axis to be the swinging centre of the arm shifted from the centre of the rotating axis of the worm wheel, engaging a worm gear to the worm wheel and coupling a servo motor to the worm gear.

Having such a structure, the delicate adjustment of pressuring force given to a work piece by the sliding member can be automatically and accurately achieved.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partially cut away front view showing a state in which the upper die 63 of a conventional rocker arm type power press is positioned at its top dead centre;

Fig. 2 is a partially cut away front view showing a state in which the upper die 63 of the conventional rocker arm type power press shown in Fig. 1 is positioned at its bottom dead centre;

Fig. 3 is a partially cut away front view showing a state in which the upper die 63 of the rocker arm type power press in a first embodiment of the present invention is positioned at its top dead centre.

Fig. 4 is a partially cut away top view showing the vicinity of the rocker arm of the press shown in Fig. 3;

Fig. 5 is a partially cut away front view showing the vicinity of a rocker arm for illustrating the operation of an apparatus for adjusting the reciprocating sliding

member of the press shown in Fig. 3;

Fig. 6 is a partially cut away sectional view showing a state in which the reciprocating sliding member of the press shown in Fig. 3 is elevated by the operation of the apparatus for adjusting the reciprocating sliding member;

Fig. 7 is a top view showing a lead frame of an IC for illustrating the cutting and bending processes conducted by a medium/small sized press represented by a rocker arm type power press;

Fig. 8 is a partially cut away front view showing the rocker arm type power press in a second embodiment of the present invention;

Fig. 9 is a top view showing the vicinity of the rocker arm of the rocker arm type power press shown in Fig. 8; and

Fig. 10 is a flow chart for illustrating the adjusting operation in the pressurising force automatic adjusting mechanism of the rocker arm type power press shown in Fig. 8.

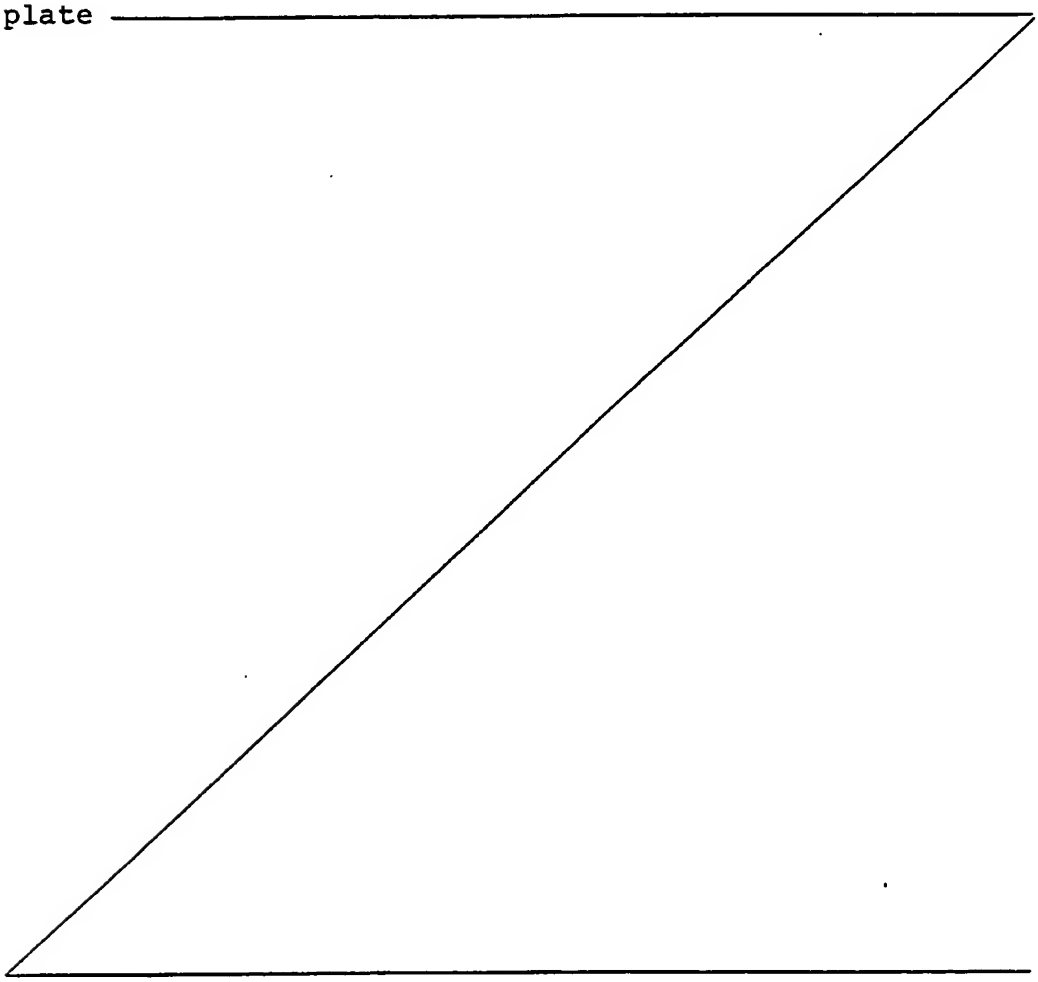
DESCRIPTION OF THE PREFERRED EMBODIMENTS

A first embodiment of the present invention will be described in conjunction with Figs. 3 to 7.

Fig. 3 shows a state in which the reciprocating sliding member of a rocker arm type power press in the first embodiment of the present invention is positioned at its top dead center. Referring to Fig. 3, the rocker arm

type power press in the present embodiment includes a rocker arm 2 disposed pivotably about an axis 1, a connecting rod 4 coupled pivotably at a coupling part 3 at one end of rocker arm 2 by a shaft 31, and a sliding member 6 coupled pivotably at a coupling part 5 at the other end of rocker arm 2 by shafts 51, 53 and a link 52. Sliding member 6 includes a shank 61 extending through a through hole 71 provided at th upper frame 7 of the main body of the press, and a movable upper die 63 fixed to its tip end with a setting member 62 therebetween.

A lower die 10 is fixed to the top of the bolster plate



9 fixed to the top of the base 8 of the main body, pole-shaped guide members 11, 11 are provided upright on the top of bolster plate 9, and guided portions 62a, 62a of setting member 62 are guided to slide along guide members 11, 11. The guided portions 62a, 62a of setting member 62 have their ends biased upwardly by a spring 12. Base 8, a side frame 13 and upper frame 7 constitute the main body 14 of the press.

Having a structure as described, the rocker arm type power press of the present embodiment shown in Fig. 3 operates as follows.

Up and down reciprocating driving force (indicated by arrow A in Fig. 3) from a driving source (not shown) acts upon connecting rod 4. For this driving source, a liquid driving source such as hydraulic pressure or an electrically operated driving source such as a pulse motor may be used. The reciprocating driving force is transmitted to rocker arm 2 through connecting part 3, and rocker arm 2 swings about axis 1 as a result. The pivotal movement of connecting part 5 caused by the swinging of rocker arm 2 is transformed into the up and down reciprocating movement (indicated by arrow B in Fig. 3) of shank 61, causing the up and down reciprocating movement of upper die 63.

When pressing work is conducted by the power press of

the present embodiment, a work piece (not shown) is inserted between upper die 63 and lower die 10 in the state as shown in Fig. 3 in which upper die 63 is at the upper end of its stroke, in other words the position of its top dead center. Then, as connecting rod 4 rises operated by the driving source, upper die 63 descends, reaching to the position of its bottom center (the state shown in Fig. 4).

The above-described structure and operation of the rocker arm type power press of the present embodiment is substantially identical to the conventional ones shown in Figs. 1 and 2. The essential difference between them consists in that in the present embodiment an adjusting mechanism 20 for adjusting the position of setting sliding member 6 is provided on upper frame 7.

Adjusting mechanism 20 includes rotating axes 21, 21 fixed to the opposing ends of the axis 1 of rocker arm 2, bearings 22, 22 for supporting rotating axes 21, 21, a worm wheel 23 fixed to one of rotating axes 21, 21, and a worm gear 24 engaged with worm wheel 23. A servo motor 25 is provided as a driving source for driving worm gear 24 to rotate both normally and reversely. Axis 1 to be the center of the swinging of rocker arm 2 is fixed to rotating axis 21 with its center O_1 a prescribed distance shifted from the center O_2 of rotating axis 21. Therefore,

rocker arm 2 is pivotably provided around axis 1, and at the time of maintenance and inspection, the rotating of worm wheel 23 causes axis 1 fixed to rotating axis 21 to pivot eccentrically about the center O_2 of rotating axis 21.

Provided between worm gear 24 and servo motor 25 are a coupling 26 for transmitting the rotating driving force of servo motor 25 to worm gear 24.

As shown in Fig. 6, upper die 63 can be elevated to upper positions by operating the servo motor 25 of adjusting mechanism 20, to the positions suitable for operation such as maintenance and inspection when some abnormality takes place between upper die 63 and lower die 10, or a work piece can be taken out upon the occurrence of defective formation of work piece.

The operation of adjusting mechanism 20 is as follows. The operation of servo motor 25 causes worm gear 24 and worm wheel 23 engaged therewith to rotate. The rotation of worm wheel 23 causes axis 1 fixed to a position shifted from the center O_2 of rotating axis 21 to pivot eccentrically about the center O_2. At that time, coupling part 3 at one end of rocker arm 2 appears to be fixed, and, therefore, coupling part 5 at the other end of rocker arm 2 pivots about coupling part 3.

Therefore, the pivotal movement of coupling part 5

about coupling part 3 causes upper die 63 to elevate to an upper position with a stroke length longer than a normal stroke length L. Consequently, sufficient space is readily and quickly secured between upper die 63 and lower die 10 in which the maintenance and inspection, etc. of upper die 63 and fixed die 10 can readily be conducted.

The position of upper die 63 in upward and downward directions can arbitrarily and readily set by rotating servo motor 25. The fine adjustment of the stroke L of upper die 63 can therefore be conducted efficiently, accurately and yet easily.

Although in the present embodiment, description has been given on a general press of medium/small size including an apparatus for adjusting the position of setting a sliding member, the present invention can be applied to other types of machines used for small sized work pieces.

For example, the apparatus for adjusting the position of setting a reciprocating sliding member shown in the present embodiments can be applied to the formation of the lead 27 of electric parts formed of ICs sealed by a resin material in the rectangular region C surrounded by two dotted chain line on a lead frame as shown in Fig. 7. More specifically, a machine including an apparatus for adjusting the position of setting a reciprocating sliding

member in accordance with the present embodiments can effectively be applied to the cutting and removal of unnecessary parts such as a tiebar 28 after sealing the resin, or the bending formation of a lead 27.

As described above, in accordance with the first embodiment of the present invention, an apparatus for adjusting the position of setting a reciprocating sliding member can produce excellent practical effects when used in a medium sized/small sized press, the effects being that operations such as taking out or unloading a work piece, or the maintenance and inspection of dies, etc. can be conducted without taking out the dies, etc. from the main body of the press when some abnormality is observed with the dies.

Therefore, degradation in productivity as a whole can be avoided efficiently and surely, which is caused by a large amount of labor required for operations such as taking out the dies from the main body of the machine for the delicate adjustment of its stroke and resetting the dies.

A second embodiment of the present invention will be described in conjunction with Figs. 8 to 10. The present embodiment as the above-described first embodiment relates to a power press of a rocker arm type, and its structure is substantially identical to the above-stated first

embodiment. Therefore, structures common to the first embodiment will be provided with common reference numerals, and the detailed description thereof will not be provided.

The present embodiment is substantially identical to the above-described first embodiment with essential difference being that adjusting mechanism 20 for adjusting the position of setting sliding member 6 is provided with pressurizing force automatic detecting portions 29, 29 for detecting automatically pressurizing force at the bottom dead center of sliding member 6. In the present embodiment, a pressurizing force detecting signal S obtained at pressurizing force automatic detecting portions 29, 29 is output as a signal for instructing the normal/reverse rotation of servo motor 25 as indicated by an arrow of a chain dotted line in Fig. 9.

The adjusting function of the adjusting mechanism 20 of sliding member 6 will be described in detail in conjunction with a flow chart shown in Fig. 10.

Step 200 is a step of a normal pressing process.

In this pressing work, pressurizing force when sliding member 6 (upper die 63) is at its bottom dead center is detected at pressurizing force automatic detecting portions 29, 29 having a strain gauge, and in step 201, the detected value of the pressurizing force is

checked whether it is within a predetermined range. If the force is out of the range, in other words beyond the upper limit or below the lower limit, it is determined that the operation of the machine cannot be continued, thereby stopping the operation (step 202), and if within the range, it is determined that the operation of the machine can be continued, so that the operation proceeds to step 203.

In step 203, it is determined whether or not the operation of the machine can be continued without adjusting the pressurizing force if the pressurizing force detected at the pressurizing force automatic detecting portions 29, 29 is within the range of the upper limit and lower limit of a predetermined pressurizing force range. More specifically, if the detected pressurizing force is within the upper limit and the lower limit of the predetermined pressurizing force range and in the range in which correction is not necessary, it is determined that the operation of the machine can be continued, and the operation proceeds to step 204 continuing the operation. If the detected pressurizing force is within the upper limit and the lower limit of the predetermined pressurizing force range, but out of the range in which corrections are unnecessary, it is determined the correction of the pressurizing force is necessary, so that

the operation proceeds to step 205.

Step 205 is a step of operating a servo motor 25 for adjusting the pressurizing force. In step 205, if the detected pressurizing force is beyond the upper limit of the range in which the correction of the pressurizing force is not necessary, the operation proceeds to step 206, and its die height is lowered so as to be within the range in which the correction of the pressurizing force is not necessary. Also, if the detected pressurizing force is below the lower limit of the range in which the correction of the pressurizing force is not necessary, the operation proceeds to step 207, causing servo motor 25 to rotate reversely, so that its die height H is increased so as to be within the range in which the correction of the pressurizing force is not necessary. After undergoing steps 206 or 207, the operation returns to step 203 in any case.

The above-described automatic adjusting operation of pressurizing force is conducted after the completion of pressing of a work piece and before the beginning of subsequent pressing of another work piece. Therefore, pressurizing force is automatically detected for every completion of pressing step, the adjustment of the pressurizing force is automatically conducted depending upon necessities. Therefore, for any of pressing

processes, suitable pressing force can always be provided.

As described above, in accordance with the second embodiment of the present invention, pressurising force at the bottom dead center of the sliding member in the press is automatically detected and the position of the sliding member in the direction of height is always adjusted appropriately and automatically by automatically increasing or decreasing its die height based on a pressurising force detecting signal if the detected pressurising force is beyond the range in which the adjustment of the pressurising force is not necessary.

Therefore, the conventional problems can efficiently and surely be solved, such problems as a large amount or labour is necessary for the setting of a die height, and the operation is cumbersome and requires skilled labour, thereby degrading productivity. A machine does not have to be stopped every time an overload is imposed upon the machine as in the conventional cases, so that productivity is further increased.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the scope of the present invention being defined by the terms of the appended claims.

CLAIMS:

1. A method of adjusting automatically the position of setting a reciprocating sliding member, comprising the steps of:

detecting pressurising force applied by a sliding member (6) at the bottom of dead centre of said sliding member (6);

adjusting the position of the bottom dead centre of said sliding member (6) by elevating said sliding member (6) by a prescribed amount based on the measured value of the pressurising force, when the measured value of the pressurising force detected in the step of detecting pressurising force is out of the upper limit and lower limit of the tolerance range of the pressurising force.

2. A method of automatically adjusting the position of setting a reciprocating sliding member as recited in claim 1, wherein

a strain gauge is used as means for detecting pressurising force in said step of detecting pressurising force, and said sliding member (6) is automatically elevated/lowered by rotating said servo motor (25) based on a pressurising force detecting signal obtained at the strain gauge.

3. A press, comprising:

a sliding member (6) capable of reciprocating, for pressurising a work piece at its bottom dead centre;

a reciprocating driving mechanism (2, 3, 4, 5) for driving said sliding member (6) to reciprocate,

pressurising force automatic detecting portion (29) for automatically detecting pressuring force at the bottom dead centre of said sliding member (6); and

an automatic elevating mechanism (20) for automatically elevating/lowering the position of said sliding member (6) at its bottom dead centre, based on a pressurising force detecting signal obtained from said pressurising force automatic detecting portion (29).

4. A press as recited in claim 3, wherein said reciprocating driving mechanism (2, 3, 4, 5) includes an arm (2) disposed pivotably about an axis (1); and

a member for transmitting driving force (4) coupled pivotably to one end of said arm (2), said sliding member (6) being coupled at least pivotably to the other end of said arm (2).

5. A press as recited in claim 3, wherein said automatic elevating mechanism (20) includes an arm (2) disposed pivotably about an axis (1); and

a member for transmitting driving force (4) coupled pivotably to one end of said arm (2),

said one end of said sliding member (6) being coupled at least pivotably to the other end of said arm (2),

the rotating axis of a worm wheel (23) being fixed to the axis (1) of said rocker arm (2), with the centre of the axis (1) of said rocker arm (2) a prescribed amount

shifted from the centre of said rotating axis (21), and

a worm gear (24) engaging with said worm wheel (23), a servo motor (25) being coupled to said worm gear (24).

6. A press as recited in claim 4, wherein said member for transmitting driving force (4) includes a connecting rod (4), said connectng rod having its one end coupled pivotably to said one end of said arm (2) by a shaft (31) and reciprocating in its lengthwise direction by the operation of a driving source.

7. A press as recited in claim 4, wherein a coupling part at the other end of said arm (2) includes a link (52), said link (52) having its one end coupled pivotably to said other end of said arm (2) by a shaft (53), and its other end coupled pivotably to said sliding member (6) by a shaft (51).

8. A press as recited in claim 7, wherein said pressurising force automatic detecting portion (29) has a strain gauge, and driving of said servo motor (25) is controlled by outputting a signal corresponding to a detected value of said pressurising force obtained by said strian gauge to said servo motor (25).

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Examiner's report to the Comptroller under Section 17
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Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii)

Documents considered relevant following a search in respect of Claims :-
1-8

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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Category	Identity of document and relevant passages		Relevant to claim(s)
A	GB 2019309 A	(GULF)	-
A	GB 0851019 A	(MASSEY)	-
A	GB 0660595 A	(ROUCKA)	-

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